

## WHAT IS CLAIMED IS:

1                   1.       A method for making a heating element adhered to a substrate;  
2   the method comprising:  
3                   applying a photocurable composition to a substrate in a pattern having  
4   one or more grid lines, the photocurable composition curable into an electrically  
5   conductive layer and having volatile organic compounds present in an amount of  
6   less than about 10% of the total weight of the photocurable composition; and  
7                   illuminating the photocurable composition to light for a sufficient  
8   period of time to cure the photocurable composition that has been applied to the  
9   substrate.

1                   2.       The method of claim 1 wherein volatile organic compounds  
2   are present in an amount of less than about 5% of the total weight of the  
3   photocurable composition.

1                   3.       The method of claim 1 wherein volatile organic compounds  
2   are present in an amount of less than about 1% of the total weight of the  
3   photocurable composition.

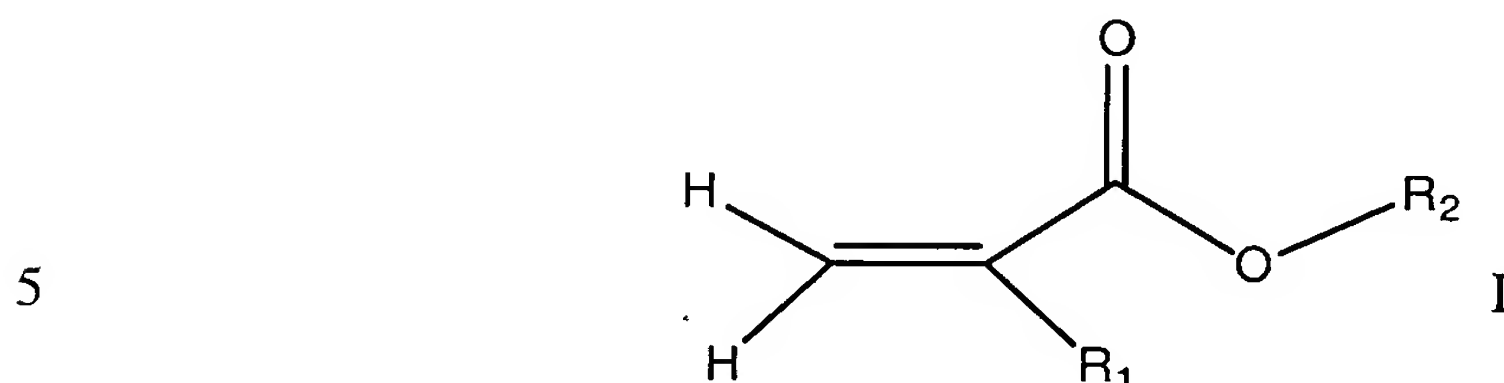
1                   4.       The method of claim 1 wherein the substrate comprise a  
2   component that is at least partially soluble in volatile organic compounds or is  
3   softened by volatile organic compounds.

1                   5.       The method of claim 1 wherein the pattern further includes  
2   one or more busbar from which the one or more gridlines extend.

1                   6.       The method of claim 1 wherein the pattern comprises a first  
2   busbar and a second busbar wherein the one or more gridlines extend between and  
3   are in electrical contact with the first busbar and the second busbar.

1                    7.        The method of claim 1 wherein the photocurable composition  
 2 comprises:  
 3 a photocurable organic mixture;  
 4 an electrically conductive composition; and  
 5 a photoinitiator.

1                    8.        The method of claim 7 wherein the photocurable organic  
 2 mixture comprises:  
 3 one or more photocurable oligomers; and  
 4 an ethylenically unsaturated monomer having Formula I:



6 wherein R<sub>1</sub> is hydrogen or substituted or unsubstituted alkyl; and  
 7 R<sub>2</sub> is substituted or unsubstituted alkyl having more than 4 carbon atoms, cycloalkyl,  
 8 cycloalkenyl, or substituted or unsubstituted aryl.

1                    9.        The method of claim 8 wherein R<sub>1</sub> is hydrogen or methyl, and  
 2 R<sub>2</sub> is isoborynl, phenyl, benzyl, dicylcopentenyl, diclypentenyl oxyethyl,  
 3 cyclohexyl, and naphthyl.

1                    10.      The method of claim 8 wherein the ethylenically unsaturated  
 2 monomer is an isobornyl acrylate monomer.

1                    11.     The method of claim 8 wherein the one or more photocurable  
2 oligomers are selected from the group consisting of an aliphatic acrylated  
3 oligomers, an acrylated epoxy oligomers, and mixtures thereof.

1                    12.     The method of claim 7 wherein the photocurable composition  
2 comprises an aliphatic acrylated urethane oligomer and an acrylated epoxy  
3 oligomers.

1                    13.     The method of claim 7 wherein the electrically conductive  
2 composition comprises a component selected from the group consisting of silver,  
3 carbon black, a doped metal oxide, and mixtures thereof.

1                    14.     The method of claim 7 wherein the electrically conductive  
2 composition comprises silver powder and silver flakes in an amount of at least 20 %  
3 relative to the weight of the silver powder.

1                    15.     The method in claim 7 wherein;  
2                    a)       the photocurable organic mixture comprises:  
3                    an aliphatic acrylated urethane oligomer is present in an amount of  
4 about 3 % to 8 % of the total weight of the photocurable composition;  
5                    acrylated epoxy oligomer is present in an amount of about 2 % to 4 %  
6 of the total weight of the photocurable composition; and  
7                    an isobornyl acrylate monomer is present in an amount of about 4 %  
8 to 8 % of the total weight of the photocurable composition; and  
9                    b)       the electrically conductive composition comprises:  
10                   silver powder is present in an amount of about 50 % to 60 % of the  
11 total weight of the photocurable composition; and  
12                   silver flakes are present in an amount of about 25 % to 35 % of the  
13 total weight of the photocurable composition.

1                    16.     The method of claim 15 wherein the photocurable composition  
2 further comprises a flow promoting agent.

1                    17.     The method of claim 15 wherein the electrical composition  
2 further includes a second conductive powder selected from the group consisting of  
3 carbon black and a doped metal oxide.

1                    18.     The method of claim 15 wherein the substrate is a flexible  
2 substrate.

1                    19.     A method for making a heating element adhered to a substrate,  
2 the method comprising:

3                    a)     applying a photocurable composition to substrate in a pattern  
4 having one or more grid lines, the photocurable composition comprising  
5 an aliphatic acrylated urethane oligomer;  
6 acrylated epoxy oligomer;  
7 an isobornyl acrylate monomer;  
8 silver powder;  
9 silver flakes; and  
10 a photoinitiator, wherein the photocurable composition has less than  
11 about 10 weight % volatile organic compounds; and  
12                    b)     illuminating the photocurable composition to light for a  
13 sufficient period of time to cure the photocurable composition that has been applied  
14 to the substrate.

1                    20.     The method of claim 19 wherein the silver flakes are present  
2 in an amount of at least 20% relative to the weight of the silver powder.

1                    21.     The method of claim 19 wherein,  
2 the aliphatic acrylated urethane oligomer is present in an amount of  
3 about 3% to 8% of the total weight of the photocurable composition;  
4 the acrylated epoxy oligomer is present in an amount of about 2% to  
5 4% of the total weight of the photocurable composition; and  
6 the isobornyl acrylate monomer is present in an amount of about 4%  
7 to 8% of the total weight of the photocurable composition;

8                   the silver powder is present in an amount of about 50% to 60% of the  
9   total weight of the photocurable composition; and  
10                  the silver flakes are present in an amount of about 25% to 35% of the  
11   total weight of the photocurable composition.

1                   23.    The method of claim 19 wherein the pattern further includes  
2   one or more busbars from which the one or more gridlines extend.

1                   24.    The method of claim 19 wherein the pattern comprises a first  
2   busbar and a second busbar wherein the one or more gridlines extend between and  
3   are in electrical contact with the first busbar and the second busbar.

1                   25.    The method of claim 19 wherein the substrate is a flexible  
2   substrate.

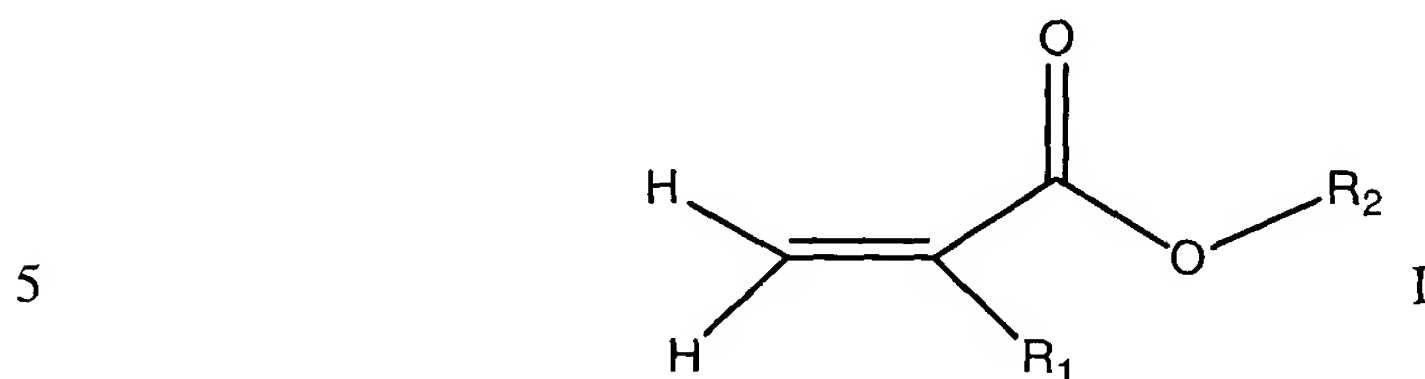
1                   26.    A heating element adhered to a flexible substrate made by the  
2   method comprising:  
3                   applying a photocurable composition to a flexible substrate in a  
4   pattern having one or more grid lines, the photocurable composition curable into an  
5   electrically conductive layer and having volatile organic compounds are present in  
6   an amount of less than about 10% of the total weight of the photocurable  
7   composition; and  
8                   illuminating the photocurable composition to light for a sufficient  
9   period of time to cure the photocurable composition that has been applied to the  
10   flexible substrate.

1                   27.    The heating element of claim 26 wherein the pattern further  
2   includes one or more busbars from which the one or more gridlines extend.

1                   28.    The heating element of claim 26 wherein the pattern comprises  
2   a first busbar and a second busbar wherein the one or more gridlines extend between  
3   and are in electrical contact with the first busbar and the second busbar.

1                    29.    The heating element of claim 26 wherein the photocurable  
 2 composition comprises:  
 3                    a photocurable organic mixture;  
 4                    an electrically conductive composition; and  
 5                    a photoinitiator.

1                    30.    The heating element of claim 29 wherein the photocurable  
 2 organic mixture comprises:  
 3                    one or more photocurable oligomers; and  
 4                    an ethylenically unsaturated monomer having Formula I:



6                    wherein R<sub>1</sub> is hydrogen or substituted or unsubstituted alkyl; and  
 7                    R<sub>2</sub> is substituted or unsubstituted alkyl having more than 4 carbon atoms, cycloalkyl,  
 8                    cycloalkenyl, or substituted or unsubstituted aryl.

1                    31.    The heating element of claim 30 wherein R<sub>1</sub> is hydrogen or  
 2 methyl; and R<sub>2</sub> is isoborynl, phenyl, benzyl, dicylcopentenyl, diclypentenyl  
 3 oxyethyl, cyclohexyl, and naphthyl.

1                    32.    The heating element of claim 30 wherein the ethylenically  
 2 unsaturated monomer is an isobornyl acrylate monomer.

1                    33.    The heating element of claim 30 wherein the one or more  
 2 photocurable oligomers are selected from the group consisting of an aliphatic  
 3 acrylated urethane oligomers, an acrylated epoxy oligomers, and mixtures thereof.

1                    34.    The heating element of claim 29 wherein the photocurable  
2    composition comprises an aliphatic acrylated urethane oligomer and an acrylated  
3    epoxy oligomers.

1                    35.    The heating element of claim 29 wherein the electrically  
2    conductive composition comprises a component selected from the group consisting  
3    of silver, carbon black, a doped metal oxide, and mixtures thereof.

1                    36.    The heating element of claim 29 wherein the electrically  
2    conductive composition comprises silver powder and silver flakes in an amount of  
3    at least 20% relative to the weight of the silver powder.